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Physiology" were commenced on February 13th. A Brush Drawing demonstration was given on January 6th in the Lecture Room of the Ladies' Council of Education.

KENDAL BRANCH.—*Hon. Sec.:* Colin Somervell, Esq.

SOUTHDOWN BRANCH :—

Brighton Centre.—Hon. Sec.: Mrs. W. Borrer, Pakyns Manor, Hurstpierpoint. It is hoped soon to form a Branch Library. Members who have books on Education which they are willing to lend, are requested to communicate with Mrs. W. Borrer. In March Miss Barnett will lecture on "Children's Food, its influence on Mind and Body."

Eastbourne Centre. Hon. Sec.: Mrs. Butt, Ingleside, Selwyn Road. The Secretary will be happy to receive communications from any lady or gentleman willing to read a paper on any educational subject at one of the Society's meetings. "Nursery Hygiene" will be the subject of the next lecture to be given in March. On January 17th Mrs. Francis Steinthal gave a demonstration in Clay Modelling.

Hastings Centre.—Hon. Sec.: Mrs. Venables, St. Bernard's Lodge, St. Leonard's. On Monday, March 5th, at 3 p.m., Miss E. A. Barnett will speak about the Union and lecture on "The Basis of Education." March 30th, Mrs. Walter Ward will lecture on "The Central Principle of Kindergarten Teaching" and "The Norland Institute."

Hon. Local Secs. are requested to send to Mr. Perrin, without delay, reports of all matters of interest connected with their branches, written on one side of the paper only, also 20 copies of any prospectuses or other papers they may print.

A GERMAN KINDERGÄRTNERIN, age 18, who is in England, will be at liberty early in April. Has been trained in the Fröbel College, and is well certificated. Can take children from three, upwards. £20. Address—Mrs. Perrin, 8, Carlton Hill, N.W.

THE
PARENTS' REVIEW
A MONTHLY MAGAZINE
OF HOME-TRAINING AND CULTURE.

"Education is an atmosphere, a discipline, a life."

AN INQUIRY INTO THE FORMATION OF HABIT IN MAN.

BY ALFRED T. SCHOFIELD, ESQ., M.D., M.R.C.S., &c.,

Chairman of Council Parents' National Educational Union.

THIS subject is one involved in difficulty, lying as it does on the borderland of the unknown, and touching the great questions of mind and brain action. I must therefore apologize in advance if I am found expressing the movements of the one in terms of the other, or in any other way using words coined for matter with reference to that which is immaterial.

I would also finally ask the forbearance of any physiologists that may be present, if in order to make the subject clear to those who have not pursued these studies, I preface my remarks with a brief summary of the general arrangement and structure of nerve tissues.

Brain structure generally.—The adult brain in man weighs between 46 and 53 ounces, with extreme limits from 23 ounces in an idiot to 65 ounces in men of the highest attainments. In women brains weigh between 41 and 47 ounces. The brain of the highest anthropoid ape weighs about 15 ounces. The brain is in two halves, right and left, and in four portions: the hemispheres and cortex, the seat of purely intelligent and voluntary actions; the middle brain, consisting of large ganglia, whence proceed the ordinary movements of animal life, not necessarily voluntary; behind this the cerebellum, or little brain, co-ordinating the movements, especially those connected with the erect position; and below, the medulla, which contains nearly all the involuntary centres connected with the maintenance of passive physical life.

The cortex, which increases in size in animals in proportion to the rest of the brain, in the ratio that intelligence supersedes instinct, is covered or rather composed of convolutions which by their number and depth afford a very fair idea of the amount of intellectual development. They increase steadily in intricacy as we ascend the animal scale; they also increase in man up to fifty years of age, after which they get gradually less marked; the brain as a whole also decreasing in weight about one ounce every ten years. The brain and spinal cord are each pierced with a continuous central tube surrounded with grey or nerve cell matter, which in its turn is surrounded by white or nerve fibre matter. The cortex or surface of the brain is covered to the depth of about a quarter of an inch with another layer of grey cell matter, the superficial extent of which is obviously greatly increased by the convolutions.

The brain is continually wasting and being repaired, the new tissue always accurately reproducing all the features of the old, whether these be congenital or acquired.

Nerve structure generally.—The nerve centres consist of three main elements: nerve cells, nerve fibres, and the groundwork or webwork in which both are embedded, called neuroglia. In the cortex this substance looks like ground glass, and under a very high power is seen to be traversed in every direction with very fine white fibres less than $\frac{1}{10000}$ of an inch in diameter. The nerve cells seem to be the starting point, and the centres of nutrition for the nerve fibres. The nutrition of the attached fibres is indeed a more obvious part of their work than the projection of impulses, which was formerly thought to be their main function. Any fibre cut off from its nutrient cell soon wastes away. In early childhood the cells are of a spherical, fusiform, or pyramidal form, with few or no interlacing nerve fibres. Nerve impulses, starting in infancy and increasing in numbers and complexity till adult life is reached, are believed to form intercommunicating nerve fibres between the cells in every direction, until in manhood though there are still left many unbranched cells, the greater number have fibres given off in every direction. In old age again a good many of them appear to be broken off and the cells blunted.

Blood supply.—The grey matter containing cells is, to a limited extent, analogous to an electric battery, of which the wires are the nerve fibres. The vitality of these nerve structures is maintained by a constant supply of fresh arterial blood. By this means when the battery has discharged its nerve force, it is speedily recharged, and as this occurs most often in the grey matter, there is about five times as much blood circulating there as in the white or fibre matter. The great proportion of blood used by the brain compared with the rest of the body is certainly remarkable. While the brain is only about $\frac{1}{45}$ part the weight of the body, the supply of blood is about one-eighth of the whole of that required by the rest of the body. The system of circulation is arranged so as to ensure the most constant and rapid change. The interdependence of mind and body is nowhere more clearly seen than in the question of blood supply. If it be suddenly cut off from any part, that part can no longer be used voluntarily; if the blood be deficient in quantity the thoughts often get confused and senseless; if it be defective in quality the very disposition seems changed, and the person gets gloomy and morose; if the temperature gets raised, delirium sets in; if effusion takes place, and the blood presses on the brain, consciousness is lost altogether in an apoplectic fit.

Ordinary functions of brain.—The brain has already been divided into four parts, and these correspond to its leading functions. The cerebrum is thus divided into upper, middle, and lower regions; or cortex, mid-brain, and medulla. The first is the seat of intellectual life, or the sphere of the activities of the *spirit* of man; the lower, of the necessary vital functions that carry on and store life's forces—the vegetive side of our life, or *body*; while the middle region is that of the functions of animal life, or what is sometimes called the *soul*. The actions connected with the cortex are voluntary, those connected with the medulla are involuntary or reflex, while those between the two partake of both varieties of action, being at first largely voluntary in character, but becoming more and more automatic in reflex as *habits* are formed. The difference of these four divisions of the brain is well shown in drunkenness. The upper region is affected first, and noisy manifestations of animal life are displayed unruled by the spirit. If the man be drunk, the middle region and the cerebellum are paralyzed, and all equilibrium and movements of animal life are lost. If the man is dead drunk, the medulla alone remains active, carrying on the functions of passive bodily life.

That the hemispheres or upper regions of the brain, and particularly the surface or cortex proper, are the centres for intelligent brain work, is proved by direct experiment, as we shall see when we consider the various actions of the brain. But we may here remark that the frontal region is supposed to be specially connected in some way with thoughts and ideas that do not result in bodily activity; the occipital and part of the parietal regions are the centres of sensation or perception, while the intervening portion is the centre for all motor impulses, which can be readily aroused by touching the part with electric stimuli.

In idiots the frontal region is found to be very deficient, while in intelligent men it is greatly developed.

Destruction of the sensory area in the cortex appears still to leave the *mechanism* of sensation (a dog will see, hear, and even feel, in a sense), but the *perception* is lost (it does not know what it sees, hears, and feels).

In the middle or motor area, districts have been carefully mapped out in the right and left hemispheres, corresponding with movements in various parts on the opposite side of the body; but it has been specially observed by Foster that the size of these areas does not correspond with the size of the part moved or the number of muscles or nerves it may contain, but to the more or less elaborate and complicated and intelligent use of the part. Thus the area for the arm is enormous compared to the leg, that for the thumb large as compared with the fingers. Another proof that the nerve fibres increase according to the complexity rather than the number of movements is found in the fact that although the number of movements of the leg must be as numerous in a dog, or an ape, as in man, the pyramidal tract in the spinal cord by which they are conveyed is twice as large in man as in the monkey, and ten times as large as in the dog.

The functions of the brain develop in a fixed order, and Sir J. C. Browne has called attention to the fact that if this natural order is disregarded in education, the result is imperfect, and the mind is never fully developed. The various senses, the motions, emotions, and intellect all come to maturity at different times.

With regard to movements, those of mastication precede those of the foot and leg, then come the hand and arm, then the proper use of the tongue and lips, later on the power of speech and writing.

Imperfectly developed motor centres produce various imperfections in the execution of the movements involved, such as stammering, twitching, an imperfect gait, &c. One point of importance remains to be noticed. The brain centres are developed by exercise of the parts they govern, and whenever fully developed, the result remains. Thus if a limb be atrophied or useless from birth, it is found that the district in the cortex remains undeveloped; but on the other hand, if the centre be once fully developed by use, and the limb subsequently lost, it is found that although the lower centre in the spinal cord may waste, the higher centre in the cortex remains perfect, being probably maintained by its intercommunication with other parts.

Nerve currents.—The more the brain is investigated the more does its broad description as a sensori-motor mechanism appear true. If we except a certain frontal area, and even this is doubtful, it appears that apart from the hemispheres and cortex, the nerve paths in the lower parts of the brain consist of sensori-motor arcs, the nerve currents arriving at the hinder part of the brain by the posterior part of the cord, and leaving the anterior ganglia, notably the corpus striatum, and descending down the front of the spinal cord in the resulting motor impulse. To use now the words of Dr. Hill, in his paper on reflex action, read here a short time since: "On these arcs, which collectively make up the lower system, are superadded arcs, the loops of which lie in the higher grey matter. At the same time, therefore, that an impulse flows across the spinal cord, as a simple direct reflex action, a certain part of this impulse is also diverted to the brain along fibres which ascend in the outer part of the spinal cord; and from the brain descending fibres carry the impulse back again to the lower arc. Accurate measurements of the time taken by impulses in travelling through the grey matter have done much to throw light upon the route they follow; but we not yet know whether we ought to speak of the conversion of a sensory into a motor impulse, in its passage through the lower network under the direction of nerve currents which originate in the higher: or whether the impulse when it reaches the lower grey matter, takes in some cases a direct cross path, while in others it makes its transit through a longer loop. One thing is quite certain, namely, that the routes which are most frequently used are the most open, and therefore the most easily traversed."

The functions of the nerve-cells are various and must be considered in detail; the molecules, or particles, of which a nerve-cell is built up, are in such an unstable condition that any stimulus readily excites them to change: this molecular change is believed to constitute a nerve-cell action; it may be of very various degrees of violence; it may exhaust the nerve-cell in proportion to its violence (and when exhausted the cell cannot act again until restored by nutrition from the blood): it may affect the substance of the cell, and especially of young growing cells, so as to leave an impression on the cell, permanent in proportion to the violence of the action and the number of its repetitions. When a nerve-cell acts, impulses tend to pass off from it along its various connecting fibres; the force and number of these impulses depends on the violence of the cell action; if this is gentle there may be only a slight impulse passing off through the largest connecting fibre (the freest channel); if the action is violent it may overflow through the various connecting fibres in impulses increasing in force and number with the violence of the cell action.

If the foot of a sleeping (or deeply thinking) person is tickled it is quietly withdrawn; that is to say the gentle skin irritation sends a gentle impulse to the sensory cells, which are gently excited, and send gentle impulses to a few motor cells; but if the foot be suddenly burnt, the sensory cell action, excited by the powerful impulse from the severely irritated skin, will be so violent that it will overflow through many more connecting fibres, and almost every muscle in the body may be thrown into violent action, causing the person to spring vigorously away from the injury.

When we speak of higher loops ascending to the cortex, and when we remember that besides these loops the brain cells send off masses of fibres that ascend to the cortex and appear to end there, and when we ask what are the sources of the impulses that control these loops and fibres that are evidently the vehicle of voluntary actions, we are brought face to face with two great questions: Is there a mind apart from the brain?" and "Can mind act on matter: or that which is immaterial on that which is material?" This subject cannot be wholly passed by, and must be here briefly touched on.

With regard to the second question Professor Clifford settles the whole point for us by the dogmatic statement that "To say will influences matter is neither true nor untrue, but simply nonsense." If this *ex cathedrâ* statement be true, I fear a good many of us talk great nonsense, and some of us will certainly do so to-night. Before answering it, however, let us consider our first question, as to the existence of mind apart from brain.

The existence of the will, which is the supreme assertion of mind, is proved by knowledge and experience. The formulæ, "*Cogito, ergo sum*," and "I know, I am, I can, I will," both express this. Feeling and thought and will are the only things we know to be real; all else is ascertained by our senses. The consciousness of effort as well as purpose in will is strong proof of its real existence. The contrary belief, that we are actually automatic, that voluntary actions are only so called because their automatic nature has not as yet been discovered, and that the mental phenomena that follow brain actions and movements, such as sensations of pleasure and so forth, are merely the products of such movements, or at any rate associates of them, as the melody is the result of playing on a harp, or motion the result of rowing in a boat, is negatived not only by experience but by the following considerations. Are we, for instance, as Dr. Courtney asks, "to consider that mental states are merely the products of movements of material molecules?" Is thought a secretion of the brain, or are we, in the words of Mr. S. H. Lewis and others, to speak of the equivalence and identity of mind and matter, so that thought and nerve action are two sides of the same thing, or to use one of the most recent similes, "that the mental and physical sensation correspond as the convex and concave surfaces of a hollow sphere?"

The answer to all this in the first place (but by many this will be considered of no weight), is that such an idea is subversive of all moral principle.

In the next place we have the power of choice, selection, memory, and attention, all of which, when carefully analyzed and considered, have no correspondence with any form of nerve action.

Consider the faculty of attention. If all mental conditions (to quote Dr. Courtney again) were simply the material result or effect of molecular agitation of the nerves, it is difficult to say why some forms of nervous agitation should produce "attention," while other forms exactly similar should fail to get themselves registered within the brain. We are looking upon some landscape; we attend to some features in this landscape; we notice some particular tree or figure, or colour, not always because it is striking, but for some capricious fancy of ours. How can this be if there be not a mind within us with laws of its own, which has a nervous mechanism, but is not the slave or result of that mechanism? The Greeks decided long since that the mind was not the music of the harp or the motion of the boat, but the player and the rower.

A great attempt has been made to refer all actions to sensori-motor reflexes, that all organisms are merely mechanisms, but although we act often on impulse, we are equally conscious of acting against it, and of the mind conquering all the sensory solicitations of the body, and refusing to transmit the natural motor impulse that would have resulted had we had no will. The brain is certainly most carefully isolated from all external impressions—in a bony case, floating in fluid, wrapped in membranes—except those conveyed by the blood and nerve currents; and yet these totally fail to account for actions contrary to these currents, and we must superadd therefore, that it is acted on by mind.

The action of an automaton, moreover, is characterized by ease, that of mind by distinct effort, and the mental fatigue is never in proportion to the amount of work done, but as to how far that work is reflex, or automatic, or voluntary.

Again, if half the cerebrum is lost, half the powers of the body go, and yet the mind remains as a whole. Moreover the brain tissue is incessantly changing, and yet through all our life we preserve the consciousness of the same personality. This cannot be through the medium of the body, which is not the same, but must be through an independent mind. The mind does not produce physical energy, but it guides and directs it, like a man on a horse. Dr. Carpenter says, "The influence of a great idea, conceived by a thinker in his closet in controlling the action of an entire nation, is utterly disproportionate to any conceivable play of molecular forces that can be exerted by the physical agency of the thinker putting his idea into speech or writing." There may be automatic thinkers, in whom the will is absent or undeveloped, but though the dominant power is absent, even such have mind as well as body. The existence of mind therefore and the freedom of the will may be said to be axiomatic truths.

And now to return to Dr. Clifford as to the relation of this mind with matter. Professor Ladd, in his *Physiological Psychology*, says: "The human brain is a vast collection of material molecules, whose constitution and arrangement is such as to connect them with certain forms of external physical energy.

"But they are also capable of standing in a yet more surprising and unique relation to a being of a different nature from their own, *i.e.*, the mind. These latter relations involve a casual connection, as truly as do the relations of the natural physical forces. That material molecules and a being of the kind called mind can be casually connected is indeed a mysterious fact; but because of its mystery it is not less to be acknowledged as a fact. The assumption that the mind is a real being which can be acted on by the brain, and which can act on the body through the brain, is the only one compatible with all facts of experience."

Neuroses or nerve actions, produce psychoses, or mind actions; thus a prick produces pain. The light on the eye is a physical action, the impression on the sight centre a physiological one, the perception of it a psychical one.

The ordinary condition of the nervous system is that of a moderately charged battery that can be discharged by the completion of the circuit and recharged by the blood. The will can complete this charged circuit. Mental causes can, as we have said, produce physical effects and physical causes can produce mental effects. "We have every reason to believe," says Professor Bain, "that with all our mental processes there is an unbroken natural succession."

We must notice however, carefully, as to automatic actions, that what we have power to will is not the action of certain muscles or nerves, but effects or results. The automatic machinery is all there; our will puts it in motion. The word voluntary muscle is therefore to a certain extent a misnomer, as few are under the direct control of the will. We cannot will the method but the result.

(*a*) Pure natural physical reflexes of three varieties :—

1. *Unconscious excito-motor actions*, generally called automatic because the exciting agency has not been discovered, such as the regulation of the size of the capillary blood-vessels of which we are unconscious.
2. *Conscious excito-motor actions*, as the acceleration of the beat of the heart, producing palpitation, of which we are conscious.
3. *Sensori-motor actions*, such as laughing when tickled, when we are conscious of the casual sensation.

(*b*) Mixed physical reflexes, which are of three varieties :—

1. *Mixed sensori-motors and voluntary actions*, such as breathing, which, though generally reflex, can be controlled to a large extent by the will through the cortex.
2. *Deferred natural reflex actions*, such as the erect position, which is apparently learned artificially, but is really a reflex action not seen at birth, but of deferred development.
3. *Instinctive habits.* These are combinations of simple reflex actions for definite purposes, but without need of intelligence. They are best noticed in animals, as in the flying of birds. Pigeons can fly after the removal of the cortex. Frogs, when deprived of the cortex, can balance themselves on a board slowly turned round, and will croak when stroked, but never move voluntarily. At the same time if all the brain is taken away they can only execute simple reflex movements with their limbs. These experiments show respectively the seats of reflex action (the cord), of complicated automatic action (the lower brain), and of voluntary acts (the cortex). It has been said by Romanes, that instinct is partly due to lapsed intelligence. It may have come out of confirmed habits, and in this case mind must precede instinct and not succeed it. This carries mind a long way down the scale, and prepares us for Professor Ladd's remark that "automatism belongs to all living protoplasm." It is for this reason it is said, "an amœba has a will of its own."

Instinct appears to culminate in the articulates, such as ants and bees, while intelligent action culminates in the vertebrata, as man. The former are like barrel organs, and can only play certain fixed tunes, however complicated, while the latter are like organs that can produce any melody at the will of the player.

(*c*) We come next to *psycho-physical acts*, mixtures of mind and brain. These are :—

1. Artificial, or acquired reflexes or habits ; these originating in the will became automatic by use, and are the chief subject of this paper.
2. Voluntary actions acting *with* physical impulses.
3. Voluntary actions acting *against* physical impulses.

(*d*) Lastly, we reach *actions purely psychical*, which we will simply enumerate :—*Reflex* ideas, desires, emotions, and perceptions produced by the mind without the will.

Artificial reflex thoughts started by the will, continued by association ; and lastly, purely *voluntary* ideas and emotions.

(*To be continued.*)